

## **MASTER 2 Fundamental and Clinical Neurosciences**

### **Internship proposal 2026-2027**

*(internship from January to June 2027)*

**Host laboratory:** **Institut NeuroMyonGène (INMG)**  
Pathophysiology and Genetics of Neurons and Muscle  
8 Avenue Rockefeller, 69008, Lyon

**Host team:** ***Team Genetics and Metabolism of the Neuronal Development***  
*J. Courchet* (<https://pgnm.inmg.fr/courchet/>)

**Internship supervisor:** Julien Courchet, [julien.courchet@univ-lyon1.fr](mailto:julien.courchet@univ-lyon1.fr)

**Project title:** How does a coupling between excitation and metabolism sculpt axonal projections in the mouse cortex

#### **Project summary :**

We investigate the cellular and molecular mechanisms governing axonal morphology during neural circuit development. We have shown that mitochondria, and more broadly metabolic pathways, play a key role in regulating axonal branching — and therefore neural network function. Metabolic defects simplify axonal terminals, which correlates with neurodevelopmental disorders (intellectual disability, epilepsy, autism, etc.).

The Master's internship project aims to determine how neuronal electrical activity modulates axonal mitochondria activity and shapes axon development. The intern will use real-time microscopy tools (calcium biosensors) to measure neuronal activity, alongside optogenetic approaches to selectively stimulate or inhibit specific neurons. This will allow us to assess metabolic consequences with precise spatial and temporal control.

This project will deepen our understanding of fundamental processes in neuronal development. Findings may extend to pathological models where neural network formation is disrupted, opening avenues to manipulate electrical or metabolic activity in disease contexts.

#### **3-5 recent publications :**

Courchet, V., Roberts, A.J., Meyer-Dilhet, G., Del Carmine, P., Lewis, T.L., Polleux, F., and Courchet, J. (2018-10-16). Haploinsufficiency of autism spectrum disorder candidate gene NUA1 impairs cortical development and behavior in mice. *Nature Communications* 2018 9:19. 10.1038/s41467-018-06584-5.

Lanfranchi, M., Yandiev, S., Meyer-Dilhet, G., Ellouze, S., Kerkhofs, M., Dos Reis, R., Garcia, A., Blondet, C., Amar, A., Kneppers, A., et al. (2024-03-21). The AMPK-related kinase NUA1 controls cortical axons branching by locally modulating mitochondrial metabolic functions. *Nature Communications* 2024 15:1 15. [10.1038/s41467-024-46146-6](https://doi.org/10.1038/s41467-024-46146-6).

Kerkhofs, M., Meyer-Dilhet, G., Polvèche, H., Yandiev, S., Tait-Mulder, J., Lilla, S., Sumpton, D., Murphy, D.J., Ahn, E.-Y.E., Bourgeois, C.F., et al. (2025-10-10). The AMPK-related kinase NUA1 regulates neuronal morphogenesis through the RNA splicing co-factor SON. *bioRxiv*. [10.1101/2025.10.10.681550](https://doi.org/10.1101/2025.10.10.681550).